



## ELT spectroscopy of resolved stellar populations

*Chris Evans (STFC, UK ATC)*

*Ben Davies (Cambridge), Rolf Kudritzki (Munich/HI), Mathieu Puech (Paris)*

*Ischia, August 2011 – Chris Evans*



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# *Spectroscopy of resolved stellar populations*

‘...but stars are done aren’t they?’  
Anonymous high-z astronomer (2007)

Fundamental properties  
still to learn

E.g. Massive stars: binarity, SNe channels etc



Tracers of star formation  
and abundances

Spectroscopy of RGB stars in LG  
Spectroscopy of blue and red  
supergiants at Mpc distances

# Deep imaging beyond the LG

ANGST Survey  
Dalcanton et al. (2009)

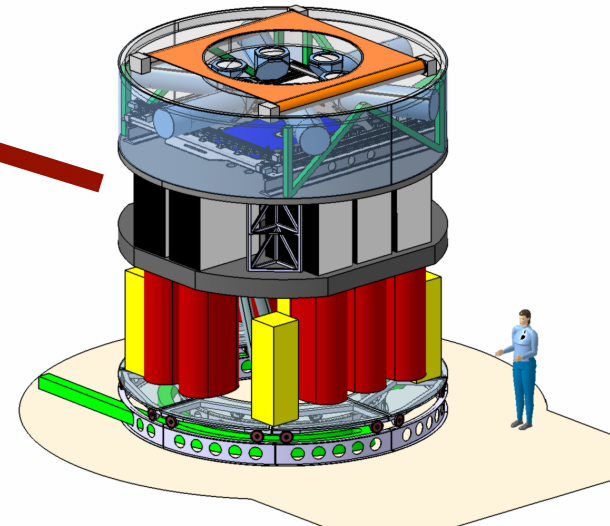
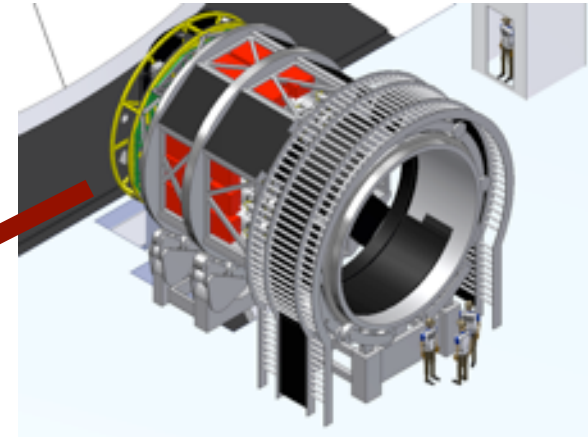
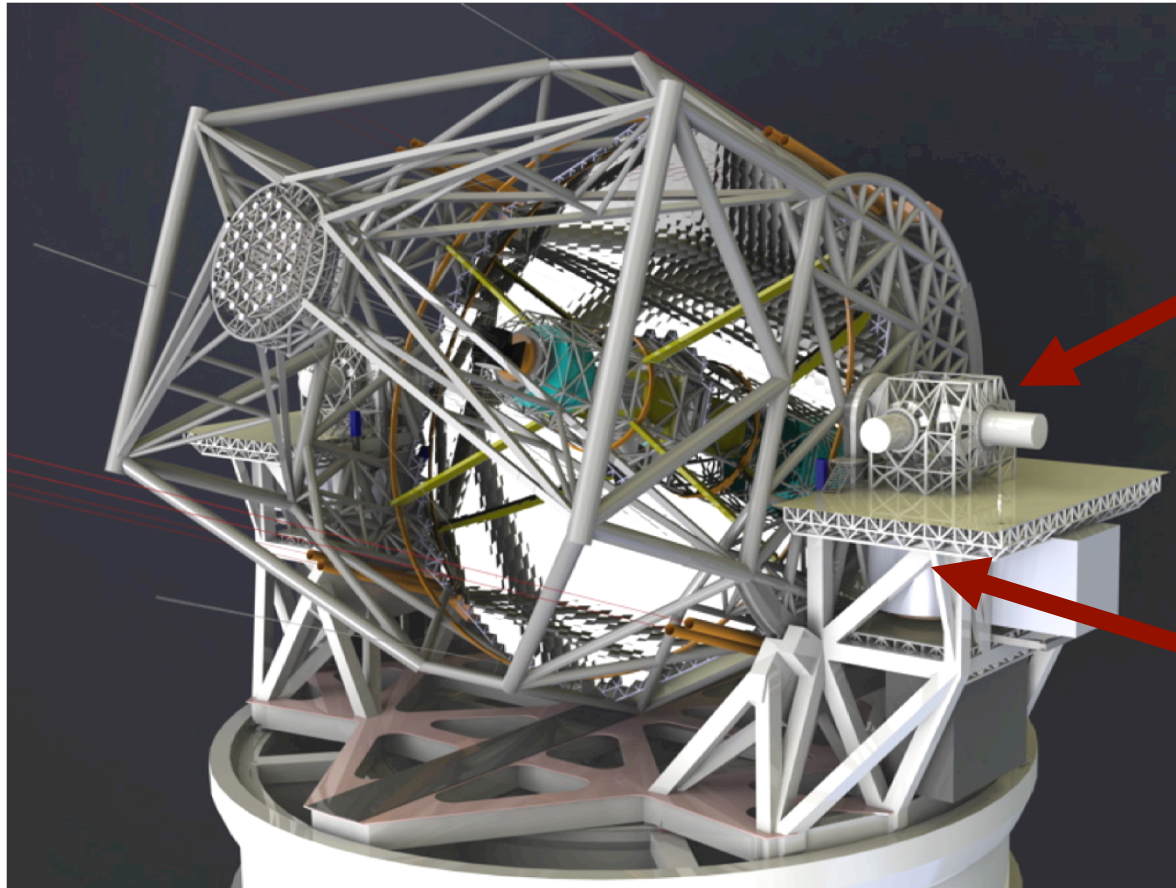


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# EAGLE



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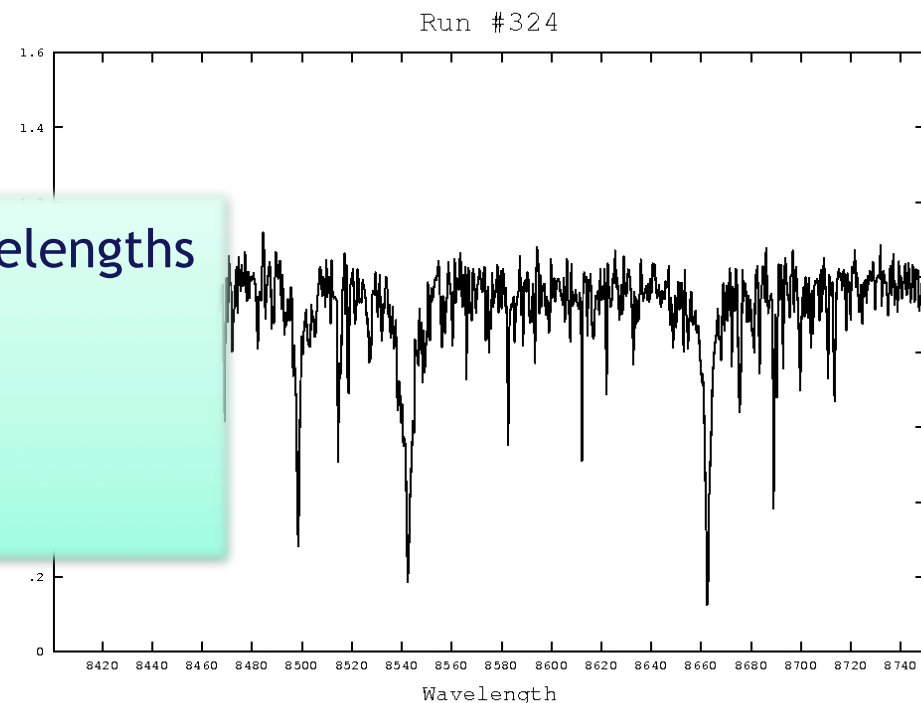
# Simulated Calcium Triplet spectroscopy

- CaT simulations for EAGLE study
- Spectral simulations using 'websim' code (Puech et al. 2008)
- Incl. tailored PSFs of AO performance

Better AO correction at longer wavelengths

Sources are intrinsically red

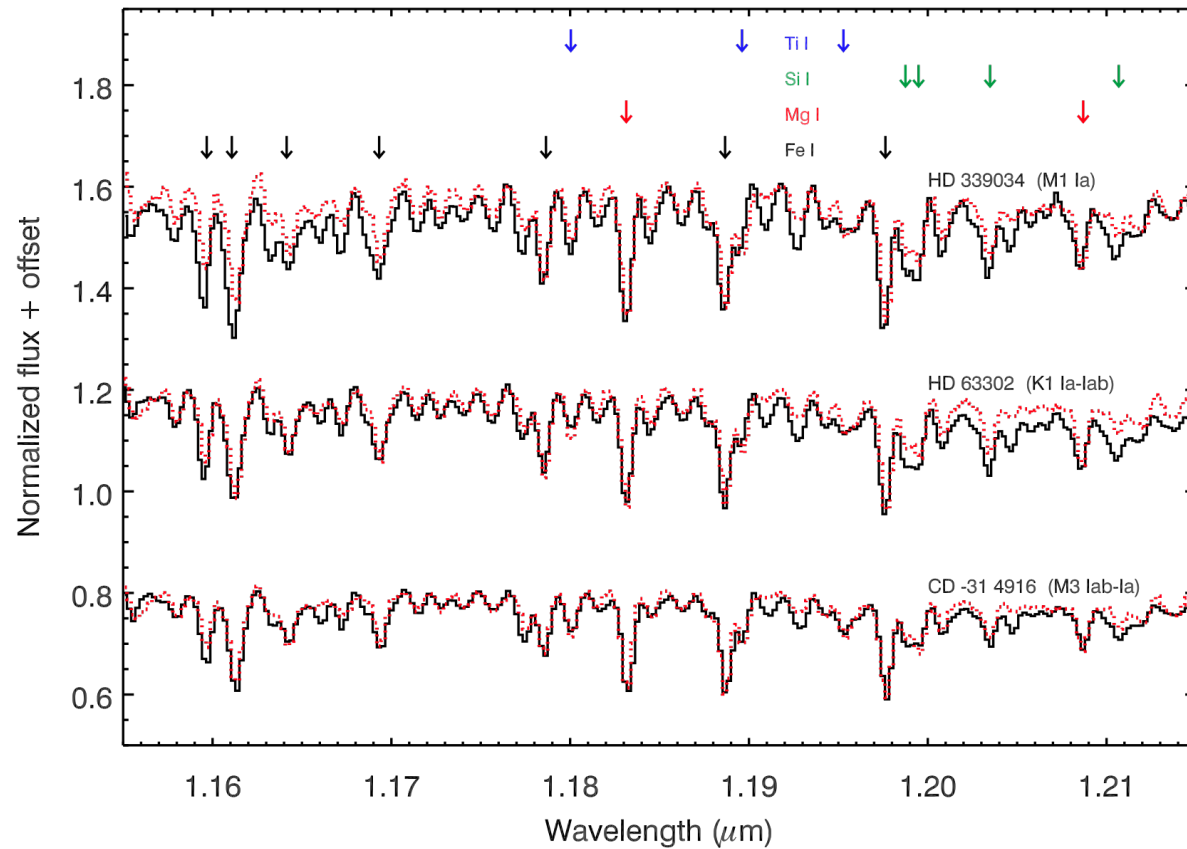
(Reduced extinction)



# Future diagnostics?

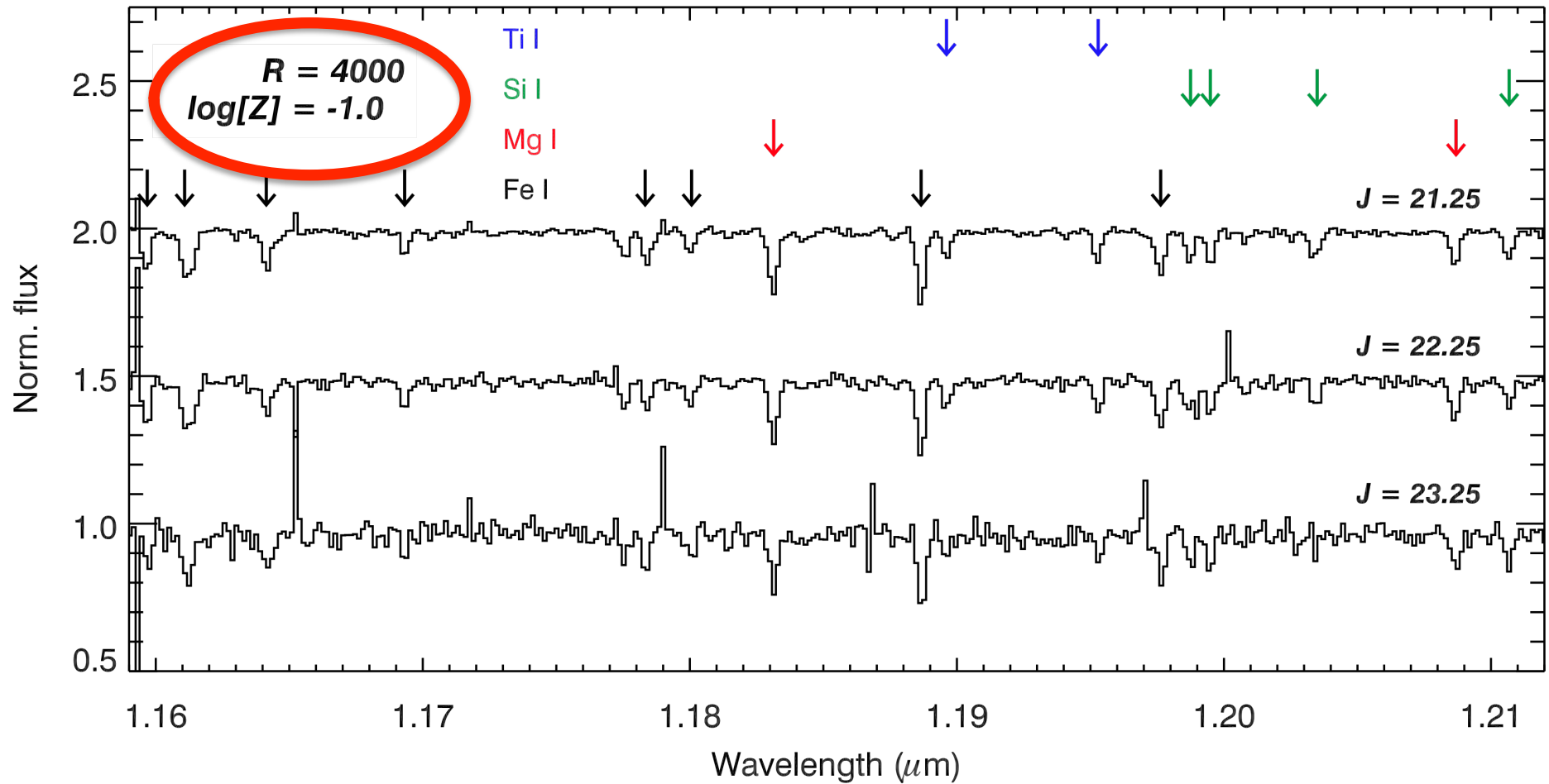
Davies, Kudritzki & Figer (2010)

J-band abundance diagnostics (at  $R \sim \text{few } 1000$ ) in red supergiants



# J-band simulations

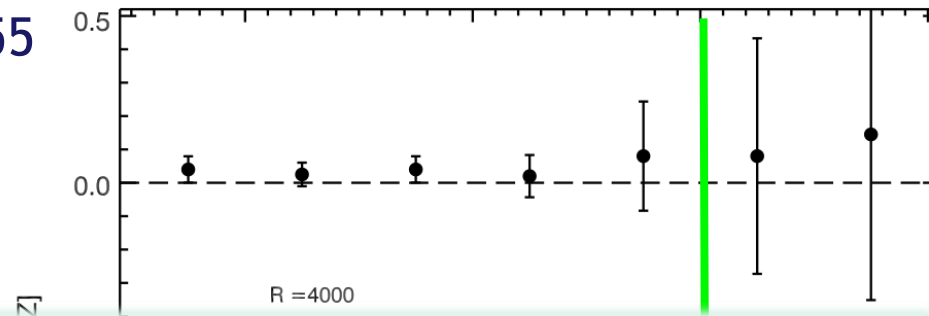
Evans et al. (2011)



# Diagnostics in the ELT era?

Evans et al. (2011)

At  $R = 4000$ , we need  $S/N > \sim 55$



Direct metallicities ( $R=4000$ ) to  $\sim 0.1$  dex to:

RGB:  $J \sim 23$   $M_J = -3.75$   $\rightarrow$   $DM = 26.75 \cong 2.25$  Mpc

TRGB:  $J \sim 23$   $M_J = -5$   $\rightarrow$   $DM = 28 \cong 4$  Mpc

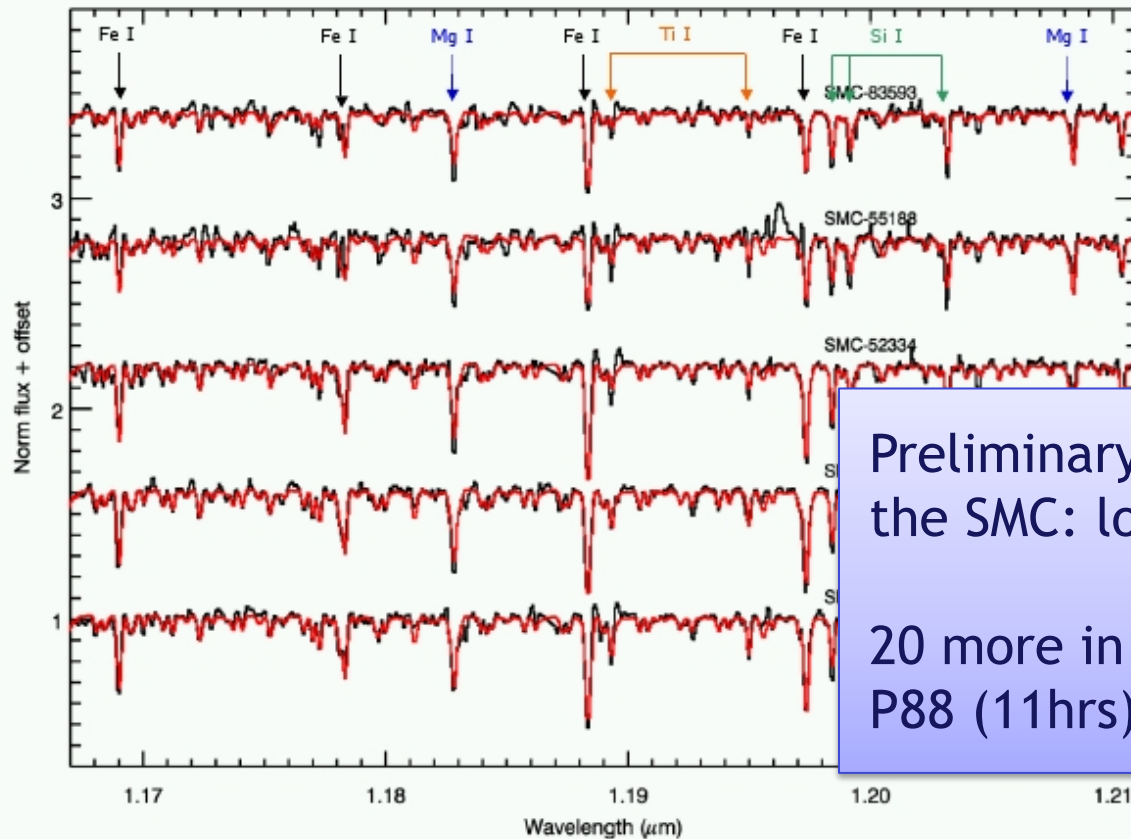
RSG:  $J \sim 23$   $M_J = -8$  to  $-11$   $\rightarrow$   $DM = 34 \rightarrow >60$  Mpc!

AO correction better in J-band, and stars are intrinsically red  $(I-J) = 0.5-1.0$



# Testing with real data

- Ongoing tests with X-shooter data (Magellanic Clouds)

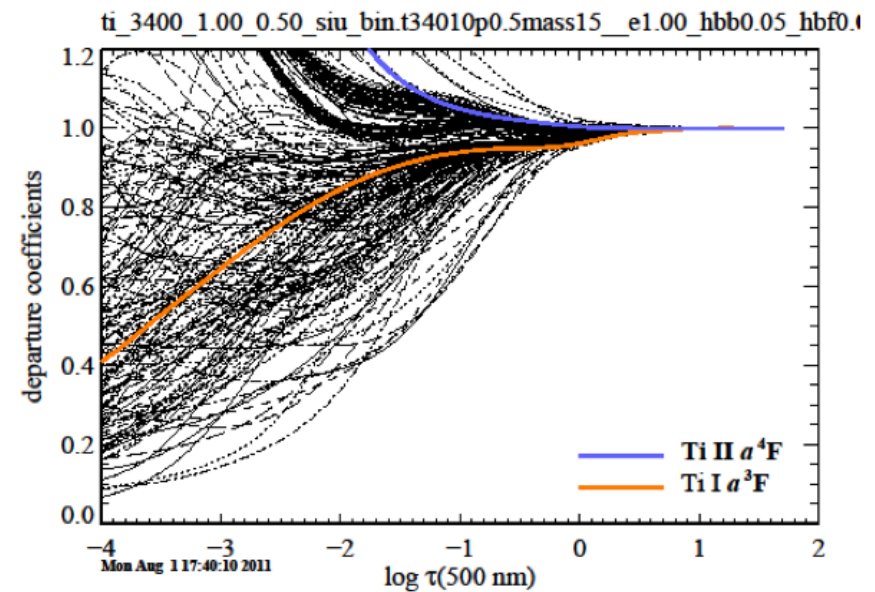
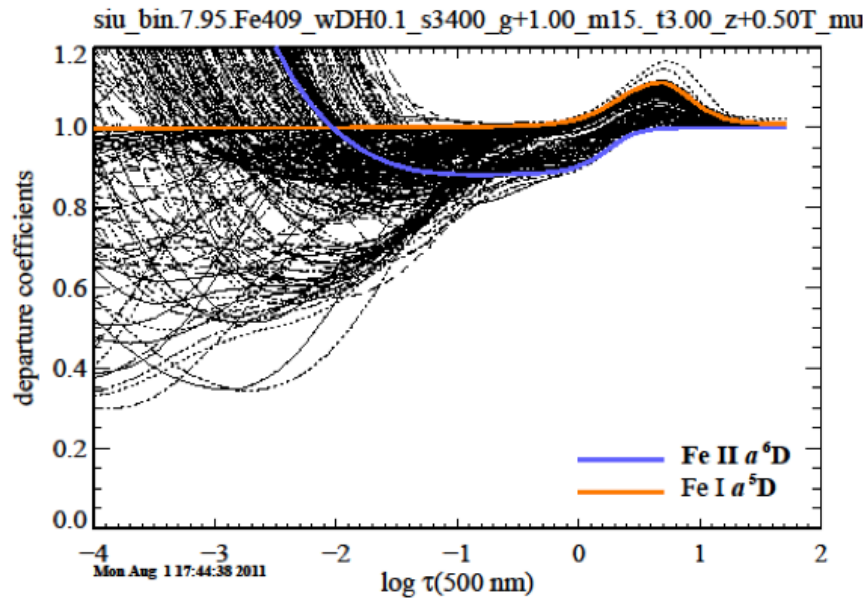


Preliminary results for RSGs in the SMC:  $\log[Z] = -0.6 \pm 0.2$

20 more in LMC/SMC approved in P88 (11hrs)

# Testing with real data

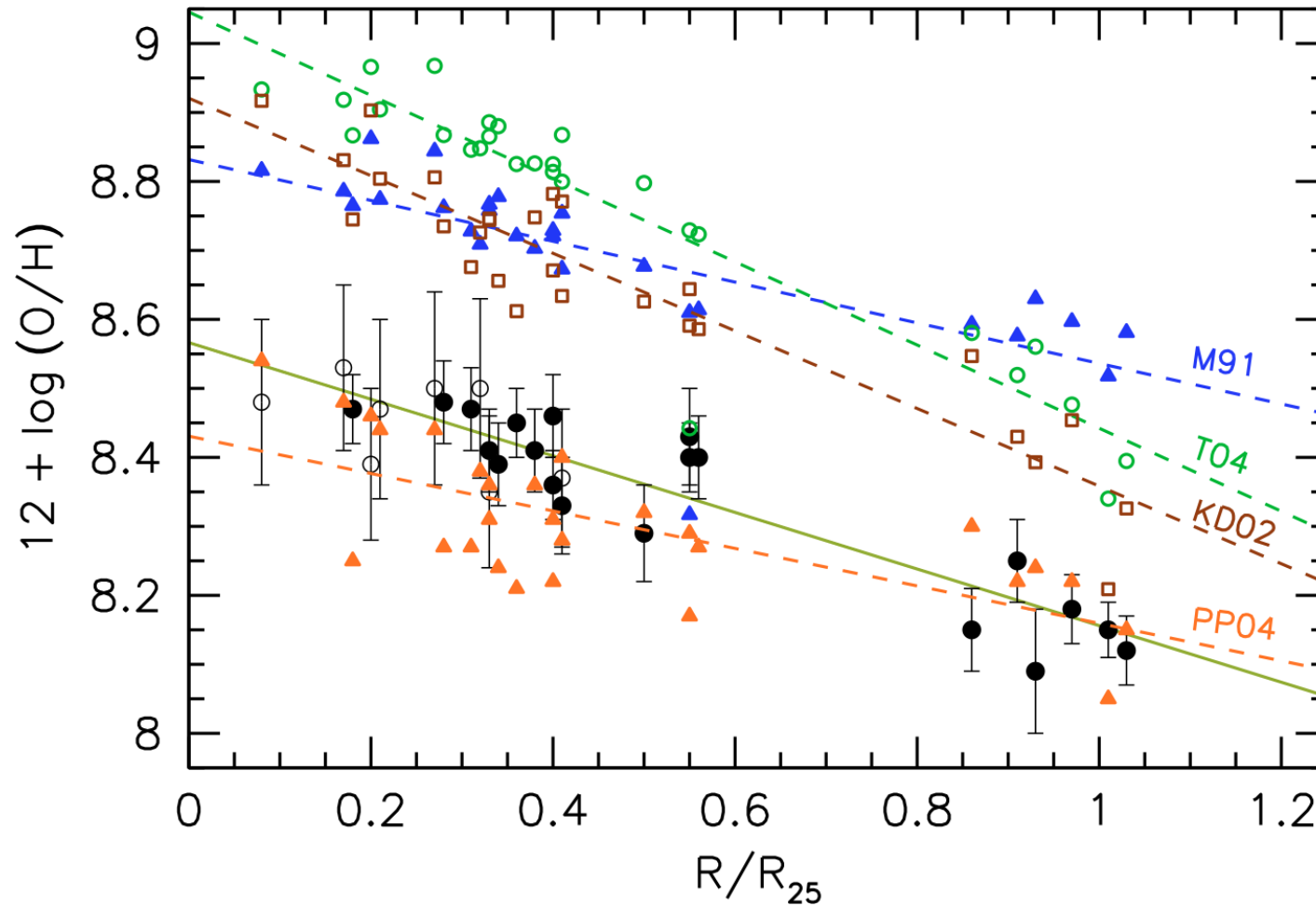
- Refining the atomic data: nLTE effects



from Maria Bergemann (USM)

# Stellar vs nebular abundances

NGC 300;  
Bresolin et al. (2009)



## *Wrap-up...*

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- J-band spectroscopy of resolved stellar populations with ELTs (+AO) looks promising.
  - E-ELT: EAGLE, HARMONI
  - TMT: IRIS, IRMS
  - JWST-NIRSpec
  - VLT X-shooter, VLT-KMOS, VLT-MOONS





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# Royal Observatory Edinburgh Workshop 2011

## Following the photons

### Astronomical Simulations for Instruments & Telescopes

Edinburgh, 10-12<sup>th</sup> October 2011

<http://www.roe.ac.uk/roe/workshop/2011/>



#### Invited speakers:

Xavier Luri (Barcelona), Andrew Connolly (U. Wash.), Michael Davidson (Edinburgh), Bianca Garilli (Milan/LAM), Rene Gastaud (CEA/Saclay), Remy Indebetouw (Virginia), Joe Liske (ESO), Robert Lupton (Princeton), Bruce Sibthorpe (UKATC), Richard Wilson (Durham)